The motion appears to accord almost perfectly with the orbit given in the *Researches on the Evolution of the Stellar Systems*, vol. i. p. 84, and it is hardly likely that the companion will ever deviate materially from the path there given.

Procyon = Bessel-Schaeberle 1.

t	$\theta_{\circ}$	$\rho_{\circ}$	Remarks.
1897·829	329·4	4″·80	About as difficult as companion of Sirius.
1898·263	326·6	4·36	
·263	326·0	4·41	
1898·296	324·6	4·68	Beautifully separated for some moments, companion distinctly purple.
·296	327·3	4·62	
1898·189	326·6	4·57	
1897·829	328·6	4·82	Boothroyd.
1898·263	324·0	4·48	,,
1898·296	328·5	5·04	,,
1898·129	327·0	4·78	

The first of these measures was made in the autumn just before we issued the catalogue of new stars, and is therefore appended to the measures of known stars communicated to the *Astronomische Nachrichten.*

The measures on the last night (April 19) were extremely satisfactory, and unquestionably indicate orbital motion since Schaeberle's discovery a year and a half ago. As the companion is distinctly purple, the appearance of the system would indicate physical connection. There can no longer be any doubt, I think, that this is the perturbing body suspected by Bessel from irregularities in the proper motion of the bright star. A refined investigation of all the meridian observations of the past fifty years, or a revision and extension of the work of Auwers in connection with recent micrometer measures, would be highly interesting. The present results, combined with Professor Schaeberle's early measures, indicate an annual motion of nearly 6°. This object, like the companion of *η Centauri*=λ_1 207, is easy when the seeing is very steady, but at other times is hopelessly lost in the rays of the large star. The companion is of about 13th magnitude, and would offer no particular difficulty save for its closeness to *Procyon.*

Lowell Observatory, Flagstaff, Arizona:
1898 *April* 22.

The Relative Motion of the Components of γ Leonis. By S. W. Burnham.

As a double star this is one of the most brilliant objects in the heavens, and, as it is within the reach of the smallest telescopes, it has received the attention of all the leading observers

in the last hundred years. It was discovered, or first recorded as a double star, by Herschel I. in 1782, who observed it long enough to recognise the change in the direction of the smaller star. In 1824 Herschel II. said, "There can be no doubt of the motion of γ *Leonis*, though it is probably less rapid than supposed by Sir W. Herschel." From that time it was generally regarded as a binary system, although the relative change was very slow, and the character of it necessarily doubtful. The entire angular motion between 1782 and 1895 is only about 30°, and since the first reliable measures of distance the change to this time is only 12°.

Notwithstanding these unfavourable conditions, attempts have been made to show not only that this is a binary, but to determine the period, and other elements of the orbit. From the measures down to 1845 Hind computed an orbit by the graphical method of Herschel, and found a period of 296 years (*Monthly Notices*, vol. vii. p. 96). As to the value of any such investigation it is only necessary to say that between 1845 and 1830, the date of the first measures which could be of any material use in such an investigation, the companion star had moved less than 5°. Of course the angles of Herschel would be useful if supplemented by complete measures covering an arc of sufficient length to clearly define the apparent path of the companion, but the character of the movement, to say nothing of the exact details of the supposed orbit, could not have been more absolutely unknown in 1845 if the star had never been measured at all.

Since that time another orbit has been computed by Doberck, using the measures down to 1875 (*Trans. R.I. Acad.* vol. xxv.; *Monthly Notices*, vol. xxxv. p. 397; *A.N.* 3448). He found a period of 402·62 years. Between this date and the first measures of Struve the angular motion was less than 10°. Obviously the problem was as indeterminate as ever so far as any particular form of orbit was concerned, even if it were conceded that it was a binary system.

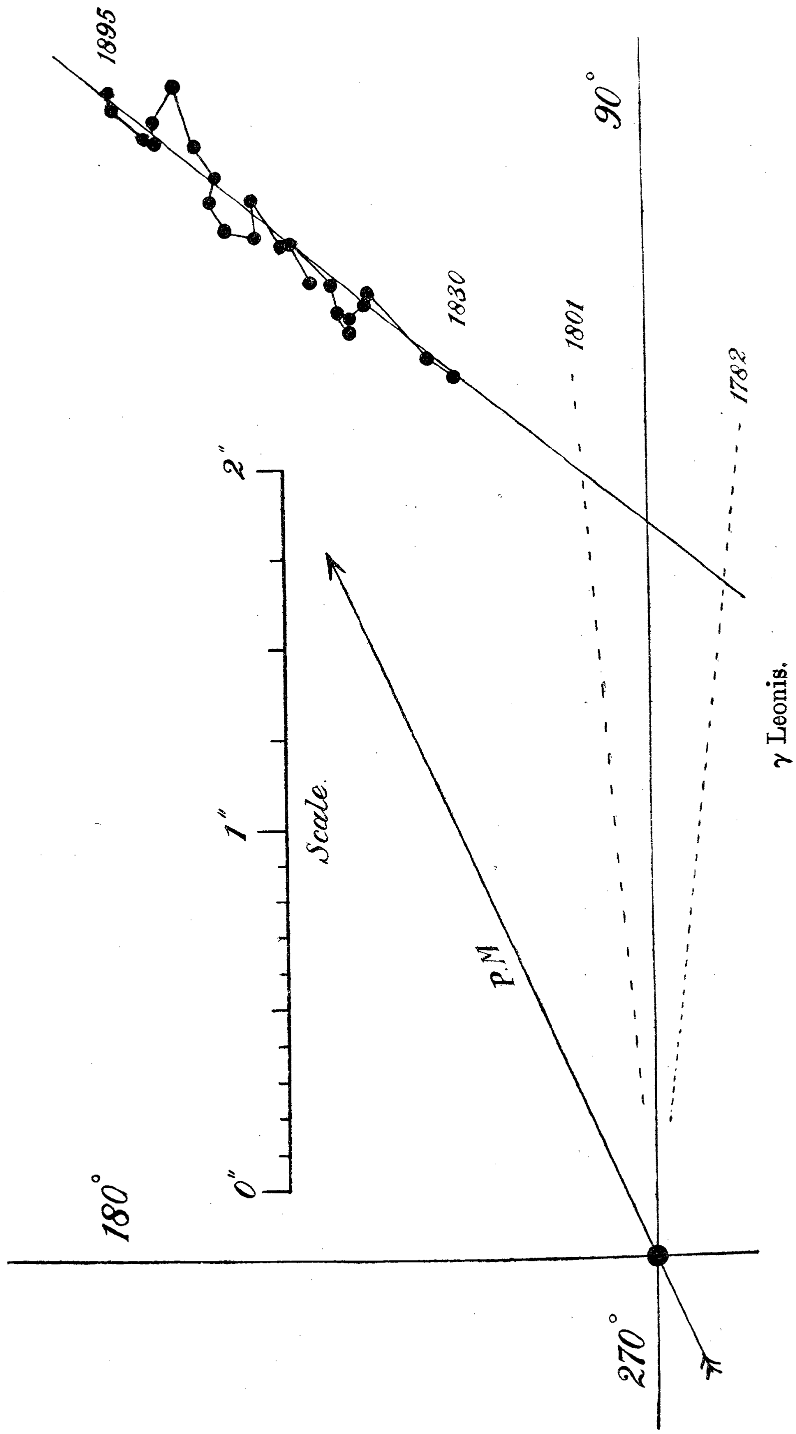
Some time since I laid down to scale some of the principal measures in the last sixty years, and called attention to what seemed to be an obvious fact that the components of γ *Leonis* were probably moving in space with nearly the same proper motion, and in nearly the same direction, like the components of 61 *Cygni* and many other pairs of that type, and showing that at all events the relative change established by the measures was perfectly accounted for by the theory of rectilinear motion. The interest of the subject, especially in view of the fact that the binary character of this pair is still insisted upon, may warrant a more thorough and complete investigation of the observations upon which the orbits referred to have been based, and the measures more recently made; and I have therefore brought together the observations of the best observers during the entire period. They are given in the following table:—

Measures of γ Leonis.

	°	″	
1782·71	83·5	...	H 2
1801·72	94·8	...	H 7
1830·38	102·4	2·52	Bes 9; Σ 11; Da 8
1833·35	103·7	2·59	Σ 10; Da 11
1840·70	106·1	2·81	OΣ 11; Ma 7; Da 5
1843·09	106·5	2·78	Da 4; Ma 14
1846·56	107·5	2·76	OΣ 12; Ma 5
1847·87	107·8	2·72	Ma 17; Da 7
1851·07	108·1	2·78	OΣ 6; Ma 16; Da 2
1853·40	108·0	2·86	Ma 46; Wr 2; Da 3
1855·30	109·3	3·01	Wn 3; Δ 16; Se 4; Wr 3
1857·51	109·0	2·89	Ma 29; OΣ 5
1860·71	109·8	3·01	Ma 9; Wr 2; Da 7; OΣ 5; Δ 12
1865·31	110·5	3·16	En 17; Se 3; Da 2; Kn 3
1868·33	111·0	3·06	Δ 9; Du 11; OΣ 3
1871·61	112·3	3·11	Δ 12; Du 20; OΣ 3; Kn 3
1875·05	112·5	3·20	Sp 12; Du 9; OΣ 2
1877·05	111·7	3·26	Δ 9; Sp 7
1878·92	112·1	3·36	Hl 10; Sp 9; OΣ 3
1880·83	112·0	3·54	Franz 4; Big 5; Sp 5
1882·88	113·5	3·47	Sp 15; Küstner 7; En 5
1884·86	113·8	3·42	Sp 18; Hl 7; En 6; Per 5; T 3
1888·56	114·2	3·44	Sp 22; B 3; Maw 3; OΣ 2
1892·32	115·0	3·55	Big 10; Lewis 4; Com 6; Lv and J 6; Glase 2; Ho 3
1895·44	114·8	3·60	Com 9; Collins 3; Scott 5; Lewis 3; Glase 2

These positions represent altogether measures on 621 nights, and each angle and distance given is, on the average, derived from measures on 27 nights. Certainly nothing in the way of micrometrical measures could be expected to give any more reliable results when the observers and the number of measures are considered. It will be remembered that this is one of the easiest stars to measure in the heavens, and no more accordant results can be looked for with present instruments and methods of observing.

These measures, and the two angles of Herschel in 1782 and 1801, are shown to scale on the accompanying diagram. It is obvious from inspection that the relative movement of the companion is sensibly rectilinear, and that all the measures are represented with substantial accuracy by the theory of rectilinear


1895
1830
1801
1782
90°
180°
270°
0"
1"
2"
Scale.
P.M.
γ Leonis.

motion. This is shown by the diagram better than it could be by any tabulated results. The annual apparent motion of the companion, derived from all the measures between 1830 and 1895, is found to be 0″·0192 in the direction of 141°·7. The corrections to be applied to the measures are shown in the following table :—

	°	″			°	″	
1782·71	+1·5	(1·94)	2*n*	1865·31	+0·3	−0·04	25*n*
1801·72	−0·8	(2·16)	7*n*	1868·33	+0·3	+0·11	23*n*
1830·38	+0·7	+0·05	28*n*	1871·61	−0·4	+0·11	38*n*
1833·35	+0·2	+0·02	21*n*	1875·05	0·0	+0·08	23*n*
1840·70	−0·4	−0·09	23*n*	1877·05	+1·1	+0·06	16*n*
1842·09	−0·2	−0·02	18*n*	1878·92	+1·0	−0·01	22*n*
1846·56	−0·4	+0·06	17*n*	1880·83	+1·4	−0·16	14*n*
1847·87	−0·5	+0·12	24*n*	1882·88	+0·2	−0·05	28*n*
1851·07	−0·1	+0·11	24*n*	1884·86	+0·2	+0·03	39*n*
1853·40	+0·5	+0·07	51*n*	1888·56	+0·3	+0·08	30*n*
1855·30	−0·4	−0·04	26*n*	1892·32	+0·1	−0·01	31*n*
1857·51	+0·3	+0·10	34*n*	1895·44	+0·7	+0·03	22*n*
1860·71	+0·2	+0·03	35*n*				

It is hardly necessary to say that these computed deviations are less in both angle and distance than the probable errors in the results obtained by the best observers with the best modern instrumental appliances ; that is, no observer could expect any closer agreement by a repetition of his measures.

Upon this theory of motion the following ephemeris is based :

	°	″
1898·5	115·9	3·68
1902·5	116·4	3·75
1906·5	116·9	3·82
1910·5	117·4	3·98
1914·5	117·8	3·96

The principal star of γ *Leonis* has a well-determined proper motion. The meridian observations are ample for the purpose, and there is every reason to believe that the movement so found is as accurate as the recognised proper motion of any other prominent star. From this motion the real movement of the companion star is readily deduced. Taking Auwers' value for the motion of the brighter star, we have for the proper motions of the two stars

A = 0″·323 in the direction of 114°·9

B = 0·340 ,, ,, 116·4

The ninth magnitude star W[1] x. 234, about 4′ distant in the direction of 290°, has a still larger proper motion, but in nearly the opposite direction. Porter gives this movement from meridian observations as 0″·495 in 270°·9. The micrometrical measures of this star from γ *Leonis* by OΣ give substantially the same value.

Yerkes Observatory:
April 26.

Photographs of the Nebulæ in the Pleiades, of Stars in the Surrounding Regions and of Spurious Nebulosity. By Isaac Roberts, D.Sc., F.R.S.

The photographs annexed are prints from the original negatives, which were taken with the 20-inch reflector and the Cooke 5-inch lens respectively, the exposures of the plates being simultaneous during ten hours. 1st, on 1897 December 22, during $3^h\ 20^m$; 2nd, on the 23rd, during $3^h\ 0^m$; 3rd, on the 25th, during $3^h\ 40^m$—three exposures during an interval of four days. The sky on each occasion was very clear.

Scale of the reflector photograph, 1 millimetre to 81·45 secs. of arc.
Scale of the lens photograph, 1 millimetre to 415 secs. of arc.

On examination of the reflector photo-negative, it is seen that the *Merope* nebula extends from that star to the distance of about 40 minutes of arc, and faintly covers an area of about the same width, in the *south*, *south preceding*, and *south following* directions; the *Maia* nebulosity also extends about 40 minutes of arc in the *nf* direction. The other stars and the nebulosities, which together form the group of the *Pleiades*, and were depicted on my photograph of 1888 December 8, are shown with but little further extensions or obvious changes of form during the nine years' interval, though the density is greater on the present one owing to the longer exposure.

The photograph taken with the 5-inch lens covers an area of the sky measuring about 17° by 17°, of which a little over 10° by 10° are shown annexed, with *Alcyone* in the centre, and it will be observed that the group of the *Pleiades* is completely obscured by the photographic effects of atmospheric glare, to which reference will be made further on. All the stars brighter than the 11th magnitude are, on the negative, visible through the glare; but the fainter stars, together with the known real nebulosities, are entirely obliterated because their light is feebler than that of the glare itself.

Other photographs of this group and of the surrounding regions were also taken with the 20-inch reflector, and simultane-